

Soil Science Society of Serbia

Soil Science Institute, Belgrade, Serbia

PROCEEDINGS

**The 1st International Congress on Soil
Science**

XIII National Congress in Soil Science

SOIL - WATER - PLANT

September 23 - 26th, 2013

Belgrade, SERBIA

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Publisher

Soil Science Society of Serbia

Soil Science Institute, Serbia

Editor-in-Chief

Prof. Dr Saljnikov R. Elmira

Printed in 100 copies

Printed by

Akademski izdanja, Beograd-Zemun, Serbia

Organized by:

Serbian Soil Science Society, Belgrade

Institute of Soil Science, Belgrade

with

University of Belgrade - Faculty of Agriculture

Chamber of Commerce and Industry of Serbia

Supported by:

**Ministry of Education Science and Technological Development of
the Republic of Serbia**

**Ministry of Agriculture, Forestry and Water management of the
Republic of Serbia - Directorate for management of forests**

**Ministry of Agriculture, Forestry and Water management of the
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Foreword

Contemporary soil related issues impose big challenges in terms of building healthy environment and soil-water-plant system. Maintaining soil fertility and healthy environment, while keeping satisfactory crop yield is a most urgent issues for soil scientists. Integrating the researches of soil scientists from different countries can help for better understanding the tasks in resolving much of the questions.

I am glad to report that in September 23-26, 2013 The Soil Science Institute in Belgrade, for the first time organized and successfully held a 1st International Congress on Soil Science, titled 'SOIL-WATER-PLANT'.

The Congress addresses to recent developments in emerging fields, and also a unique opportunity to meet scientists, to have stimulating discussions and to hear about the latest developments in soil science. This congress is of big importance at a time when soil degradation, environmental changes, crop growing difficulties etc., make soil scientists and environmentalists more concerned than ever about issues dealing with the scientific basis of optimizing soil use and conservation.

The Congress is co-organized by Serbian Soil Science Society, University of Belgrade, Faculty of Agriculture and The Chamber of Commerce of the Republic of Serbia.

This book comprises a total 65 full original papers, submitted by 252 authors from 13 countries from Europe and Asia. There are 7 invited papers in plenary section. The Book is organized in accordance with the Congress sections:

1. Plenary Section
2. Soil Use, Fertility and Management
3. Soil- Water- Environmental Protection
4. Soil In Space And Time

I hope that this first International Congress will become a tradition and will expand its geography continuing to gather the soil scientists from all the continents.

Finally, I would like to thank the Ministry of Education Science and Technological Development of the Republic of Serbia; Ministry of Agriculture, Forestry and Water management of the Republic of Serbia - Directorate for management of forests; Ministry of Agriculture, Forestry and Water management of the Republic of Serbia - Directorate for management of agricultural lands; Ministry of Natural Resources, Mining and Spatial Planning of the Republic of Serbia; Megra d.o.o. and DPS Chromatorgraphy for their valuable financial support in holding the Congress.

The Chairman of the organizing Committee of the Congress

Dr. Maksimović Srboljub

General Secretary

Dr. Saljnikov Elmira

SUCCESSFUL APPLICATION OF "AGRO KAPILARIS" CONCEPT IN AGRICULTURAL PRODUCTION

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ABSTRACT

On the experimental plot in Boljevci, Belgrade, the preliminary experiments were carried out in the open fields and in greenhouses in 2009. The aim was to investigate the effects of new ways of subsurface irrigation system "Agro kapilaris" related to the vegetable and field crops production. The application of "Agro kapilaris" in a protected area indicated the need to change the agro technique for planting when compared to the traditional way to get maximum effect: powerful and increased root system of plants and significant increase in yield. A two-year study in the open field was a novel application of this subsurface irrigation system has shown numerous advantages of subsurface over traditional surface irrigation. In conditions of extreme drought, in 2012 year, the results of comparative monitoring "Agro kapilaris" versus surface irrigation confirmed multiple positive effects in favor of "Agro kapilaris".

Keywords: irrigation, "Agro kapilaris", greenhouse

INTRODUCTION

The growing population worldwide requires the food production in a sustainable way to provide safe and nutritious products, while protecting natural resources such as water and soil and reducing the negative effects of land use on the climate (Yang, 2006; Swain *et al.* 2013). Unpredicted weather changes and occurrences of draughts can lead to devastating effects on food production and

socioeconomic quality of life of general population. The subsurface irrigation could provide an answer to limitations of “drop by drop” and “sprinkle” irrigation (Rouphael *et al.* 2006, Wang *et al.* 2007), which are costly for equipment and management and generally require high levels of energy and water and most importantly, short service life, up to 15-20 years (Jin Qiu *et al.* 2012). In previous paper the author Zloh have reported a new concept for subsurface irrigation *Agro kapilaris*¹ that firstly has a long service life over 70 years, then low energy costs and thirdly it is environment and soil friendly. Here, we demonstrate the successful application and great potential of this novel “*Agro kapilaris*” subsurface irrigation system in the greenhouse cultivation and open field farming.

MATERIALS AND METHODS

Standard methods were used to monitor the effects of “*Agro kapilaris*” system, “drip” and “sprinkle” irrigation techniques. The main methodology is given in the papers of this book by author Zloh. More detailed presentation and interpretations of the results of this study will be available in the next papers.

RESULTS AND DISCUSSIONS

Experiments in a protected environment (2009-2011)

Result of the research in 2009: The “Drop by drop” irrigation, degrades the structure of the soils, after an extended period (Đurović *et al.* 2010). “*Agro kapilaris*” maintains the structure of the soil and leaves it unaltered. Therefore, it preserves the soil as an invaluable natural resource. (*Photo 1*).

The health-beneficial and environmental aspect: After a few repetitions of experiments in enclosed areas, in 2010 after parallel monitoring the relations between the temperatures and relative humidity, a conclusion was reached where the work environment conditions with the *Agro kapilaris* system are very favorable for work. In the greenhouses that are irrigated using the drip system the observed temperatures and relative air humidity indicate unfavorable working conditions as well as the conditions where the plants could be more susceptible to diseases. (*Photo 2*).



Photo 1. Experiments in a protected environment, pepper was selected as an experimental culture (2009)

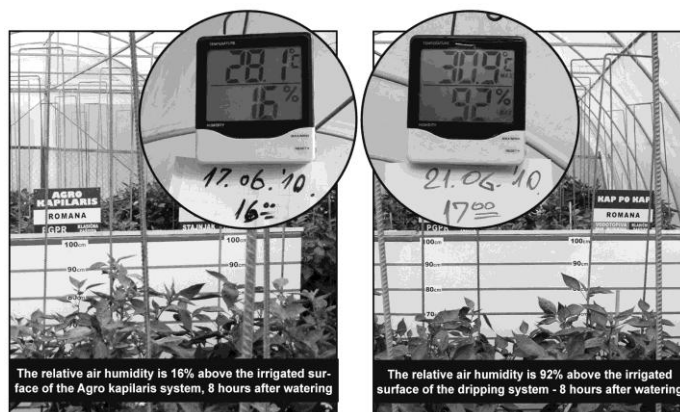


Photo 2. Environmental-helt benefit aspect - peppers (2010)

Result of experiment in 2011: Agro kapilaris has higher yields peppers than drip system averages for 20-30%. Agro kapilaris showed much more advantages than the dripping system for growing plants in greenhouses, however there is a need to validate this method for other conditions and vegetables.

Experiments in the open (2010-2012)

Sub-surface irrigation is not commonly used for massive open field farming due to various limitations (Bošnjak, 1999). We have

previously shown that AgroKapilaris no such limitations and can meet the water needs of plants through a variety of topological settings and up to 180 meters of water reservoirs with extremely low pressure of 0.2 bar, these were achieved with minimal requirements for electricity. Similarly, the quality of the soil is not perturbed by using this system. Here we demonstrate result of micro experiment and projection yield per hectare and the superior performance of AgroKapilaris irrigation system in comparison to generally used sprinkling systems.

Tab. 1. Shugar beet yield under “Agro kapilaris” and “Sprinkling”, 2012

Planting distance cm	Row spacing m	Rroots row ⁻¹	Rroots ha ⁻¹	Net mass 10 roots kg	Digestion %	Yield t ha ⁻¹	Sugar content t ha ⁻¹
Agro kapilaris							
20	0.5	500	99500	20.7	13.66	134	18.3
Sprinkling							
20	0.5	500	99500	13.5	15.4	87	13.4

As seen in the Table 1, the total sugar content per hectare was higher for 26.5% under the “Agro kapilaris” comparing to the sprinkling irrigation system.

In the extreme droughty 2011 and 2012 years the yield of soybean under the “Aghro kapilaris” system was 6.5 - 6.9 t ha⁻¹, while under the spinkling irrigation the soybean yield was 4.8 - 5.4 t ha⁻¹.

Based on the obtained two-year results, it is estimated that the yields of sugar beet and soybean are approaching their genetic potential when the of subsoil irrigation by “Agro kapilaris” system is applied.

Similarly to sugar beet and soybean the yield of tomato was also significantly increased under the “Agro kapilaris” irrigation system in comparison to sprinkling irrigation: the yield of tomato average for 2011-2012 under “Agro kapilaris” was 96.9 t ha⁻¹, while under spinkling was 64.3 t ha⁻¹.

CONCLUSIONS

The two-year preliminary experiments proved that the “Agro kapilaris” can satisfy the needs for water of various farm vegetables in the open field even during the extreme droughts without affecting the soil quality.

The "Agro kapilaris" irrigation concept has all the necessary attributes of an irrigation system that can answer future demands for efficient farming, which is doesn't depend on weather conditions. The demonstrated advantages should be implemented in crop and vegetable production both in open fields and protected environments. The flexibility of the system will allow further developments and incorporation with other agro technique that could lead to even better effects.

The next necessary step would be the investment into validation of use of the system in farming of different crops and conditions for thorough research, which will speed the process of introducing the "Agro kapilaris" concept into general use.

- The system is proved to be economically profitable and cost effective,
- "Agro kapilaris" preserves the water resources because water is delivered only when is needed by vegetation and
- Application of subsoil "Agro kapilaris" system significantly improves the vegetable yields.

REFERENCES

- YANG H.S. 2006: Resource management, soil fertility and sustainable crop production: Experiences of China. *Agric. Ecosys.& Environ.* 116(1-2):276
- SWAIN D.K., RAWADE Y.A., MOHANTY U.C. 2013: Climate impact analysis and adaptations for sustainable rice production system. *Earth systems and environmental science climate vulnerability. Understanding and addressing threats to essential resources.* P.25-35
- DJUROVIC N., PAVLOVIC R., PIVIC R. 2010: Uticaj navodnjavanja na strukturni sastav pseudogleja u proizvodnji u zaštićenom prostoru. *Acta biologica Iugoslavica - serija A: Zem, i bilj.* 59(1):35-37
- ROUPHAEL Y., CARDARELLI M., REA E., BATTISTELLI A., COLLA G. 2006: [Comparison of the subirrigation and drip-irrigation systems for greenhouse zucchini squash production using saline and non-saline nutrient solutions.](#) *Agric. Water Manag.* 82(1-2):99-117
- WANG Y., CAI H.J., CHEN X.M., ZHENG J., WANG J. 2007: [Effects of Crop Rootzone Non-Pressure Subirrigation on Tomato Physiological Characteristics, Yield, and Quality.](#) *Agric. Sci. in China* 6(6):673-681
- BOSNJAK Dj. 1999: Navodnjavanje poljoprivrednih useva, Univerzitet u NovomSadu, Poljop. fakultet. Mladost, Odžaci, P 1 - 340
- JINQIU, XIAOHOU S., JUNYI T., ZHENG X. (2012): Economic Analysis of the Wetland Reservior Subirrigation System in Southern China. *Procedia Environmental Sciences* 12 Part A, P. 206-211.